Application No.: 09/659,948
Filing Date: 09/12/2000

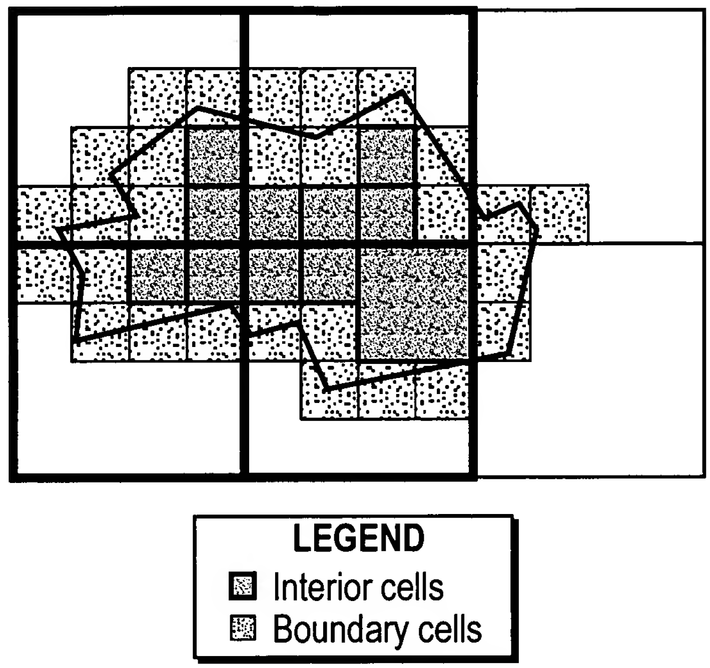


FIG. 1
(PRIOR ART)

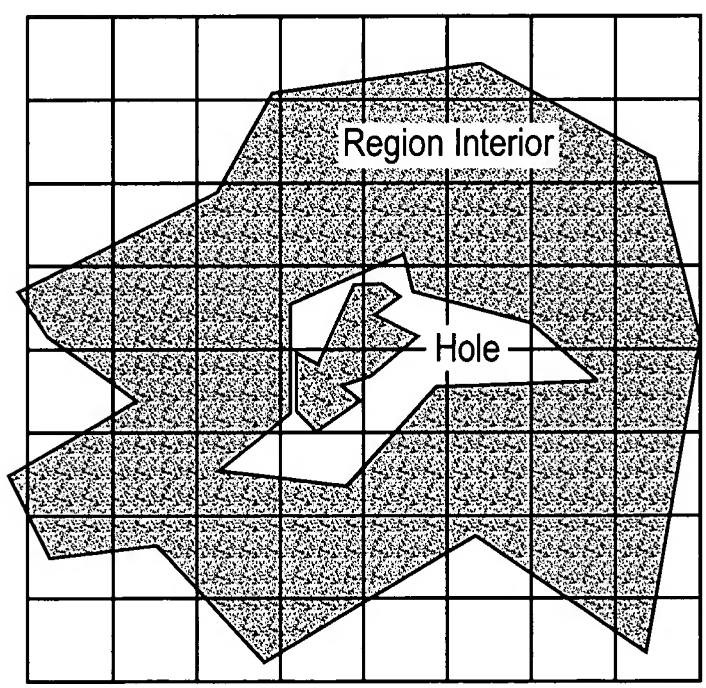


FIG. 2
(PRIOR ART)

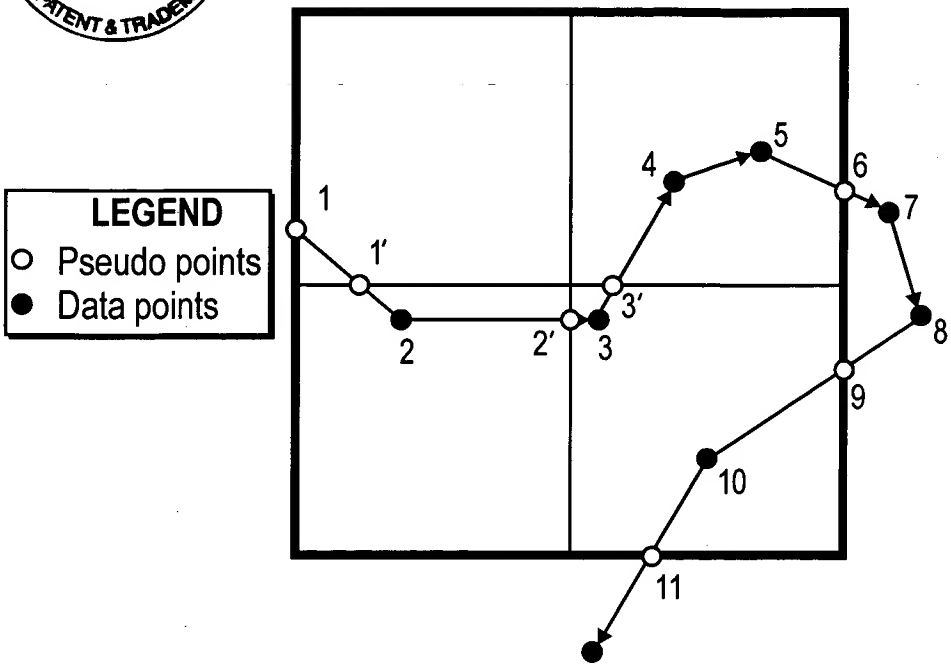


FIG. 3

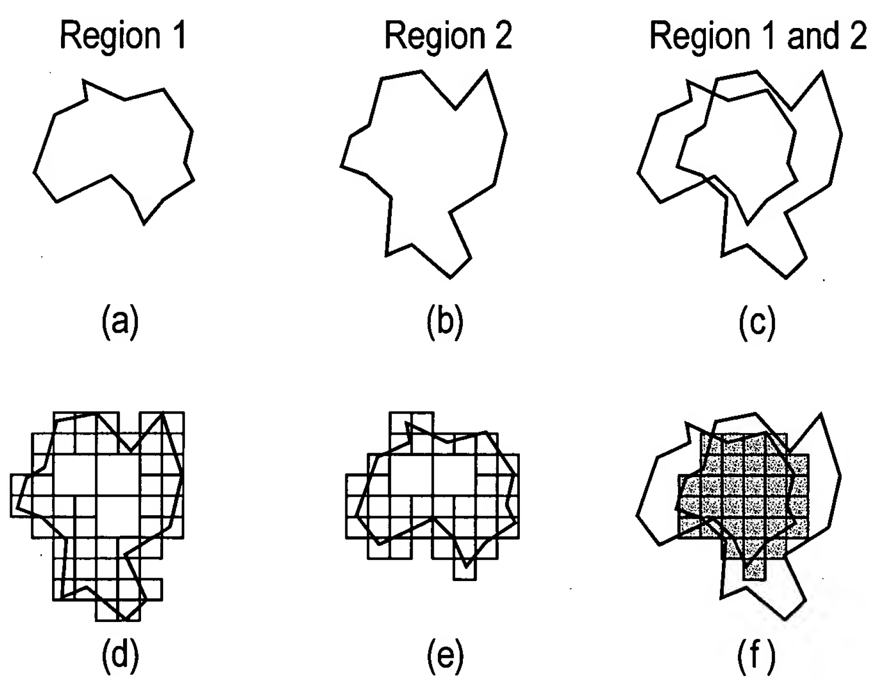


FIG. 4
(PRIOR ART)

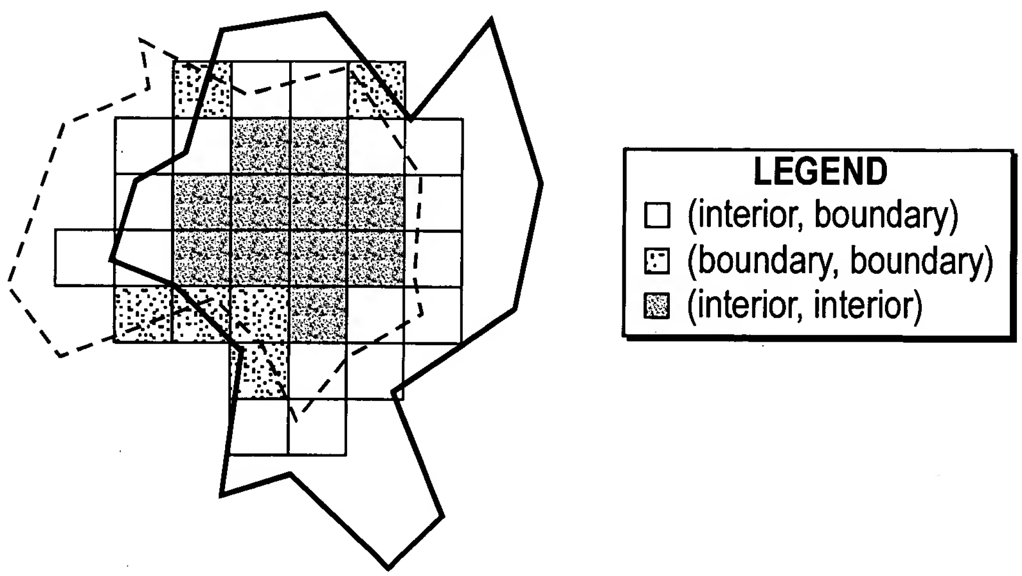


FIG. 5
(PRIOR ART)

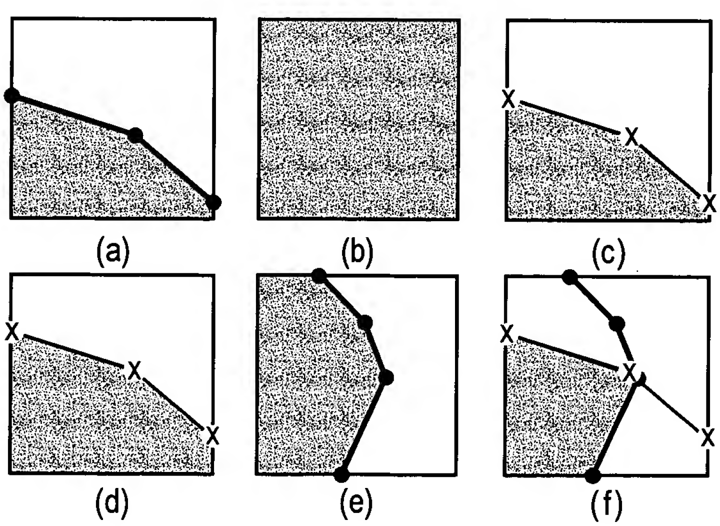


FIG. 7
(PRIOR ART)

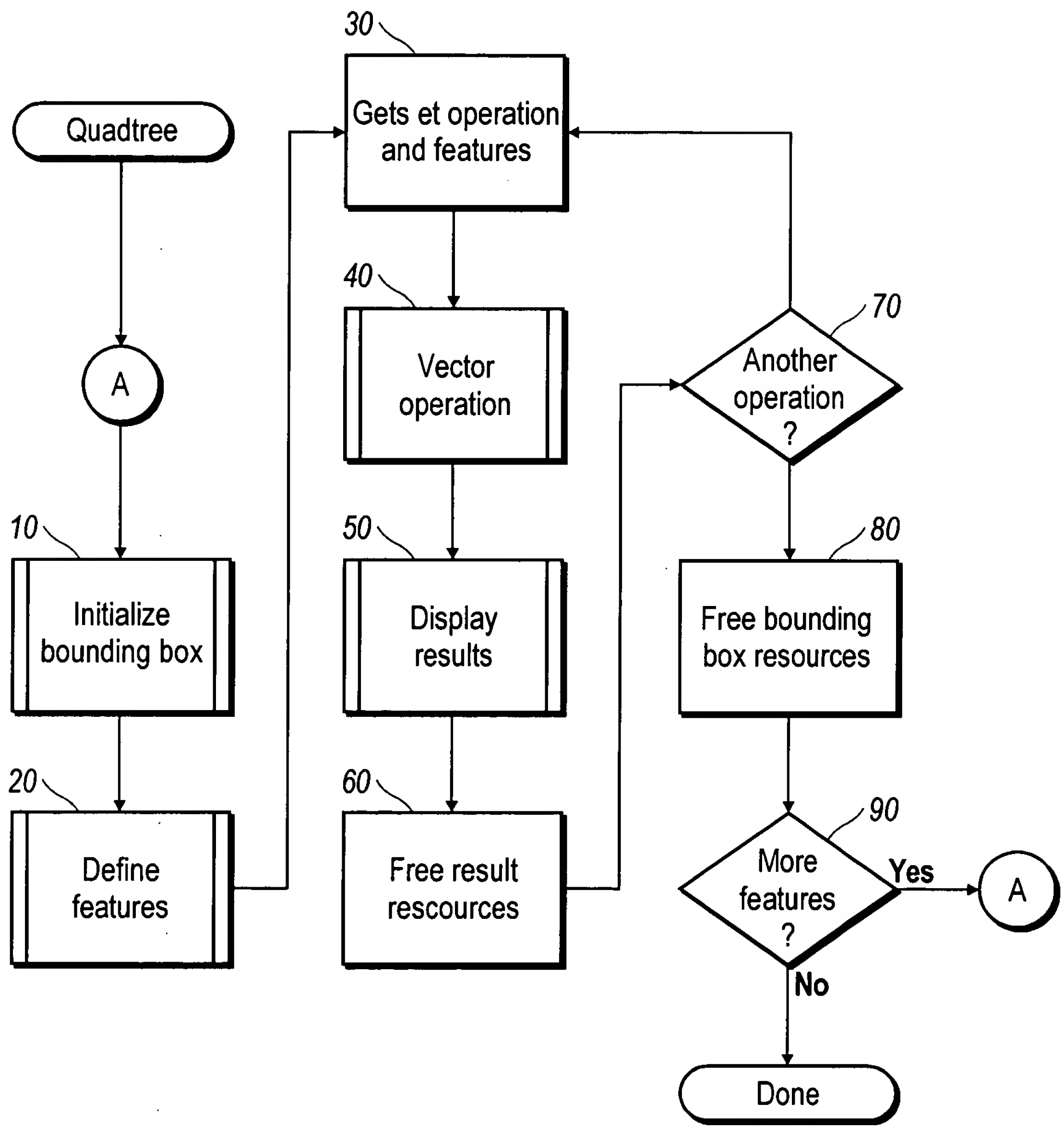
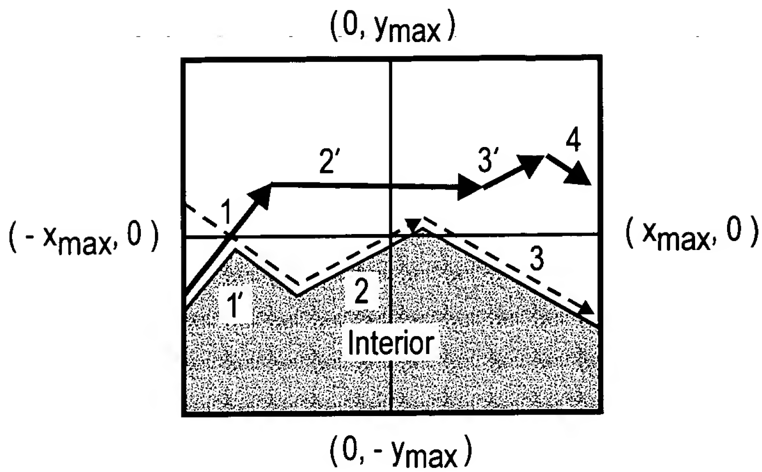
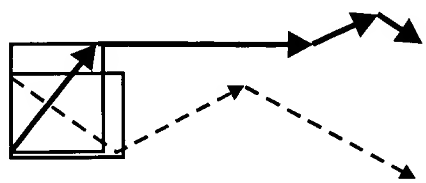

30
Gets et operation and features
40
Vector operation
50
Display results
60
Free result rescources
Quadtree
A
10
Initialize bounding box
20
Define features
70
Another operation ?
80
Free bounding box resources
90
More features ?
Yes
A
No
Done

FIG. 6



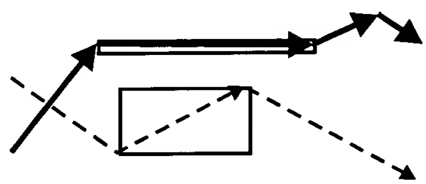
Line segment intersection cases

The two bounding boxes associated with the first two tuple-pairs from both features intersects as shown to the right



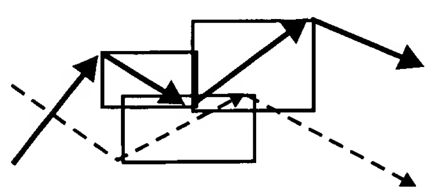
Case 1

The bounding boxes associated with the second set of tuple-pairs do not intersect



Case 2

In the case to the right, two black line segments must be elevated for intersection with a single dashed line segment



Case 3

FIG. 8

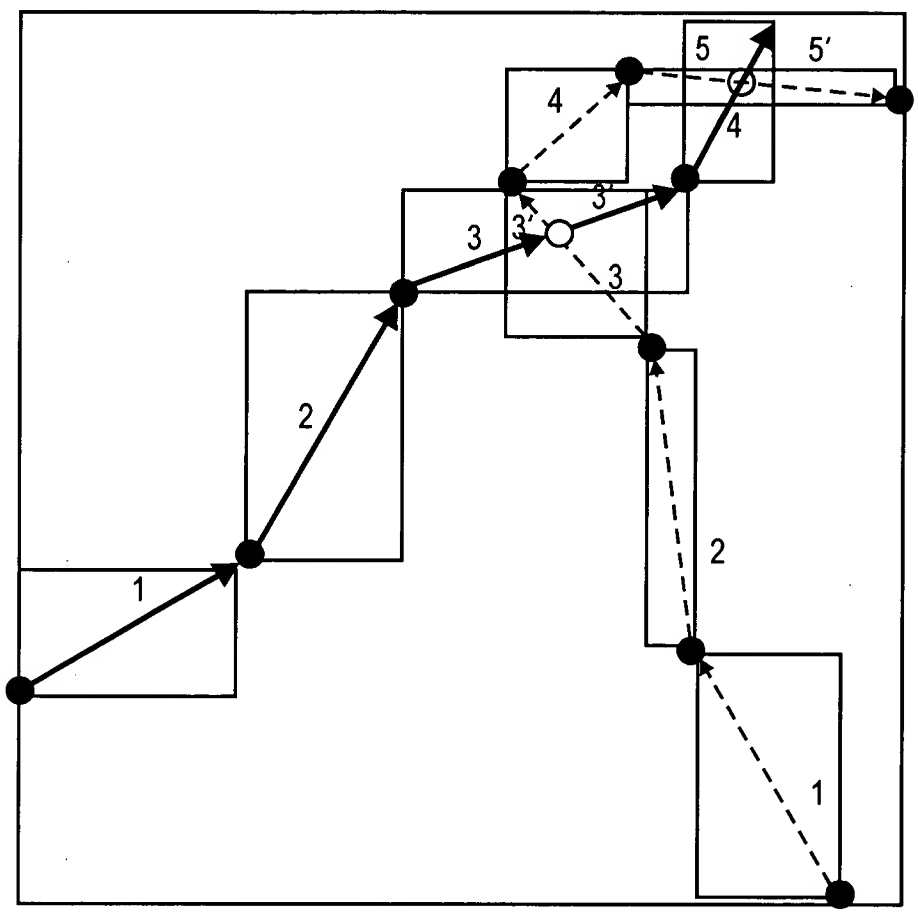


FIG. 9

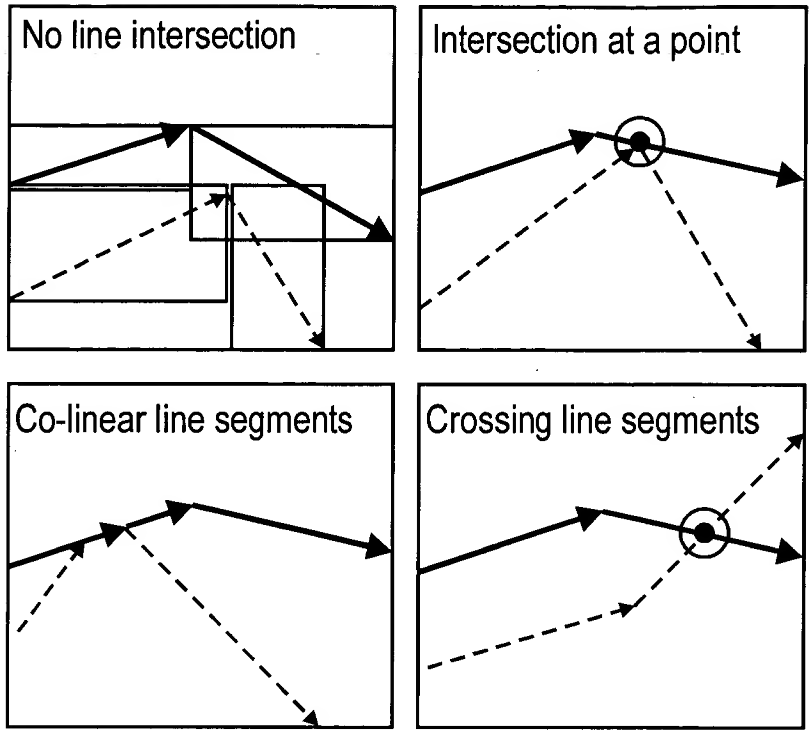

No line intersection
Intersection at a point
Co-linear line segments
Crossing line segments

FIG.1 0

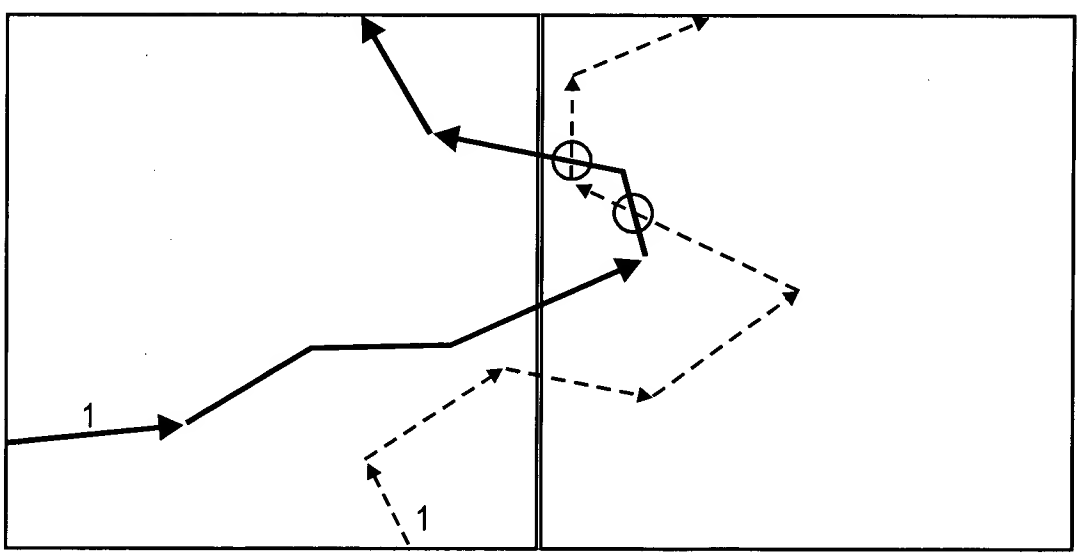

1
1

FIG. 11

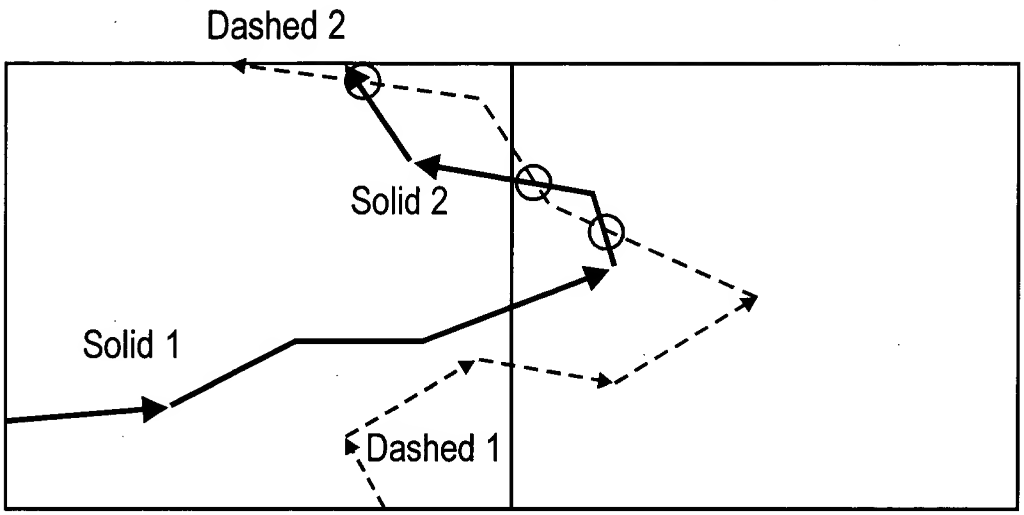


FIG.1 2

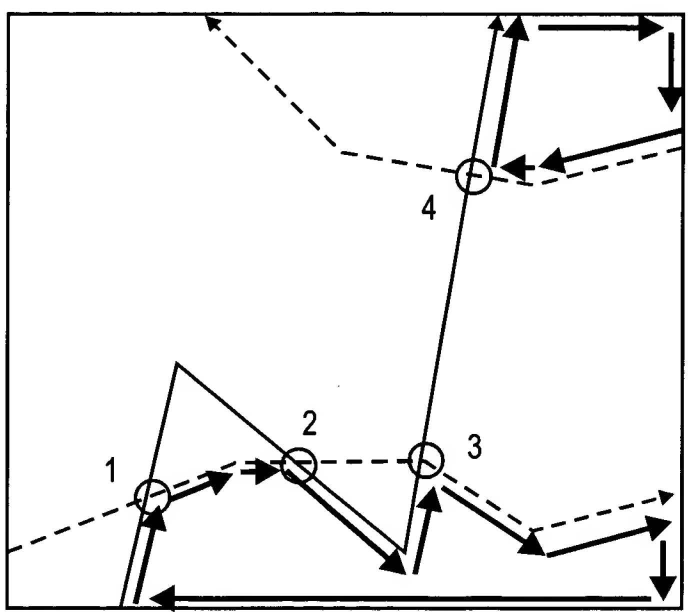


FIG.1 3

Possible cell entrance/exit point combinations

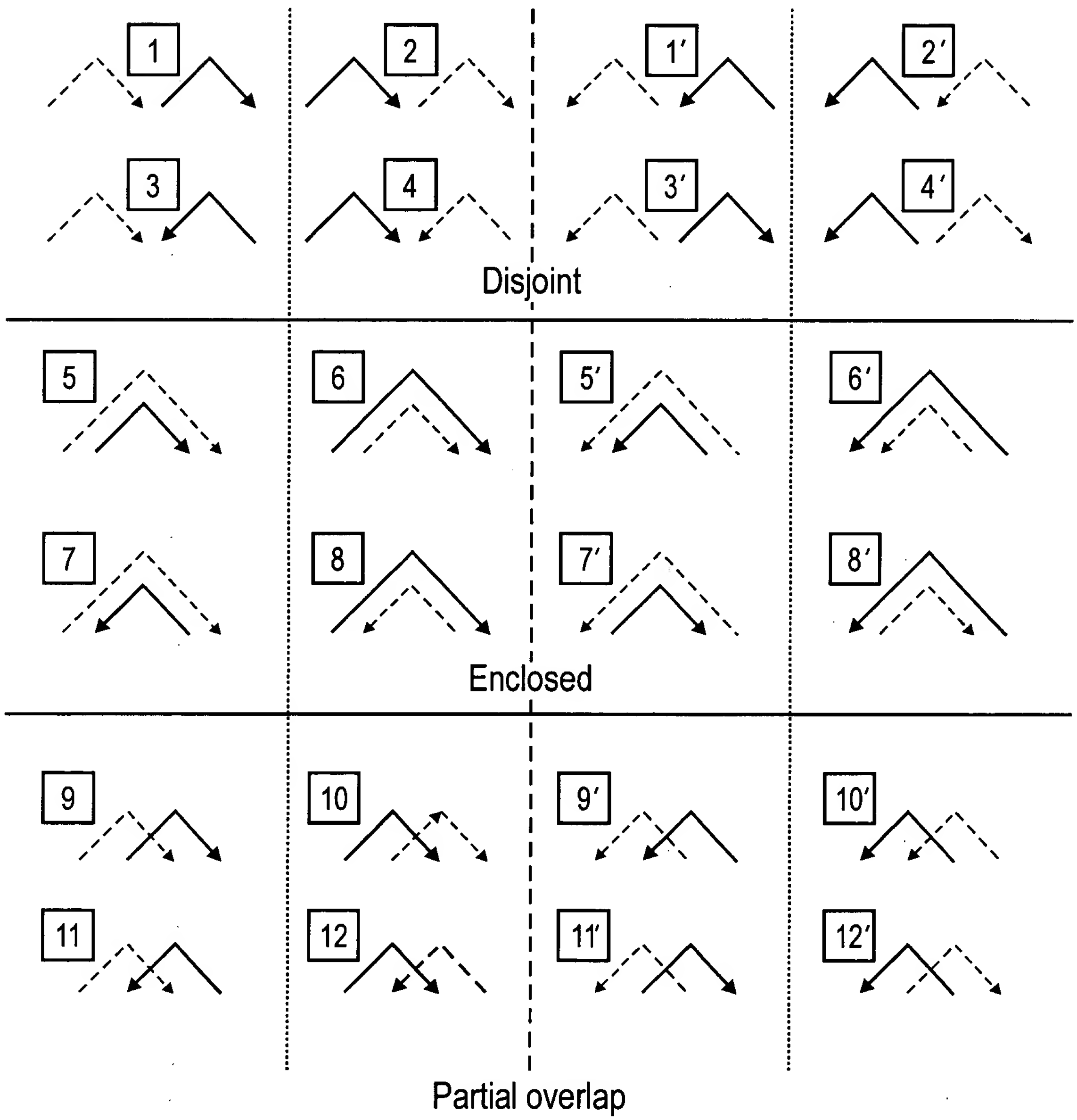


FIG.1 4

Entry/Exit Relationship	Class	Begin point for first cycle (inside is " to the right ") **Intersection**	Begin point for first cycle (inside is " to the right ") **Union**	Begin point for first cycle (inside is " to the left ") **Intersection**	Begin point for first cycle (inside is " to the left ") **Union**
$D_E D_X S_E S_X$	I	First intersection point of solid or dashed feature (Null if no intersect points)	Pseudo points (S_E and D_E)	Pseudo points (S_E and D_E)	First intersection point of solid or dashed feature (Full cell if no intersect points)
$D_E S_X S_E D_X$	II	Pseudo points (S_E and D_E)	First intersection point of solid or dashed feature (Full cell if no intersect points)	First intersection point of solid or dashed feature (Null if no intersect points)	Pseudo points (S_E and D_E)
$D_E S_E S_X D_X$	III	Pseudo point S_E	Pseudo point D_E	Pseudo point D_E	Pseudo point S_E
$D_E S_E D_X S_X$	VI	Pseudo point S_E	Pseudo point D_E	Pseudo point D_E	Pseudo point S_E
$D_E D_X S_X S_E$	IV	Pseudo point D_E	Pseudo point S_E	Pseudo point S_E	Pseudo point D_E
$D_E S_X D_X S_E$	V	Pseudo point D_E	Pseudo point S_E	Pseudo point S_E	Pseudo point D_E

Application of table:

Follow specified boundary entrance feature, accumulating intersection and/or union cycles until all polyline intersection point tuples in the cell have been exhausted.

Cycles alternate systematically along the specified entrance feature between contributions to intersection and union.

Cycles are completed when they close on themselves. The implicit boundary-closing segments of a boundary-closing cycle are not actually represented in the general product.

Comments:

As is apparent from the above formulation, intersection and union are effectively dual operations. The set operation generation procedure is similar regardless of the ordering convention of the polygon tuples (clockwise or counter-clockwise oriented), reflected in the symmetry observed within the above table.

Note that the classes are grouped into pairs. Classes I and II involve inverse operations;

Classes III and VI employ identical generation operations, as do Classes IV and V .

FIG.1 5

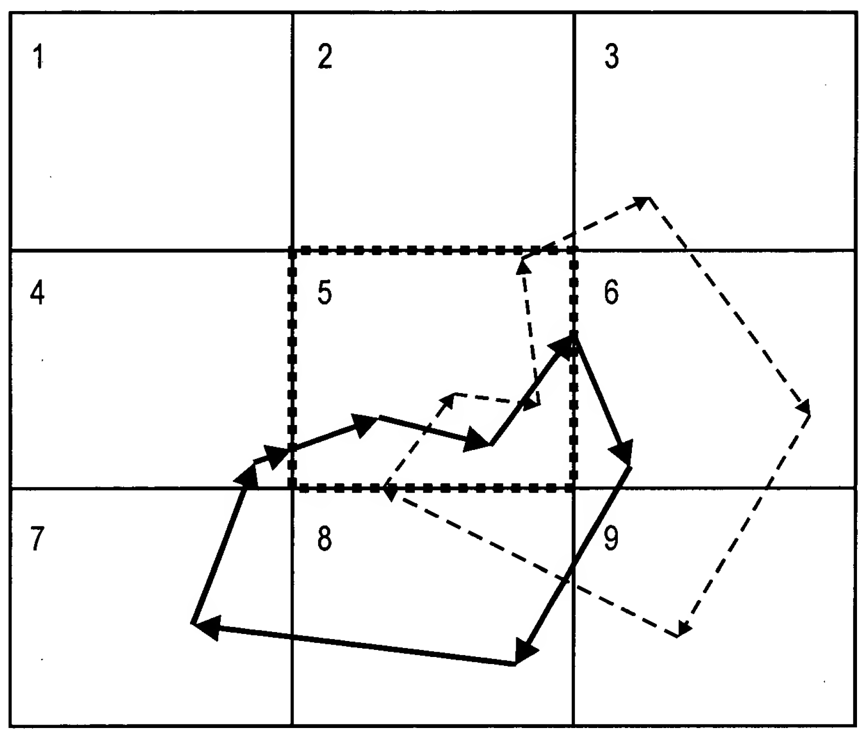


FIG. 16

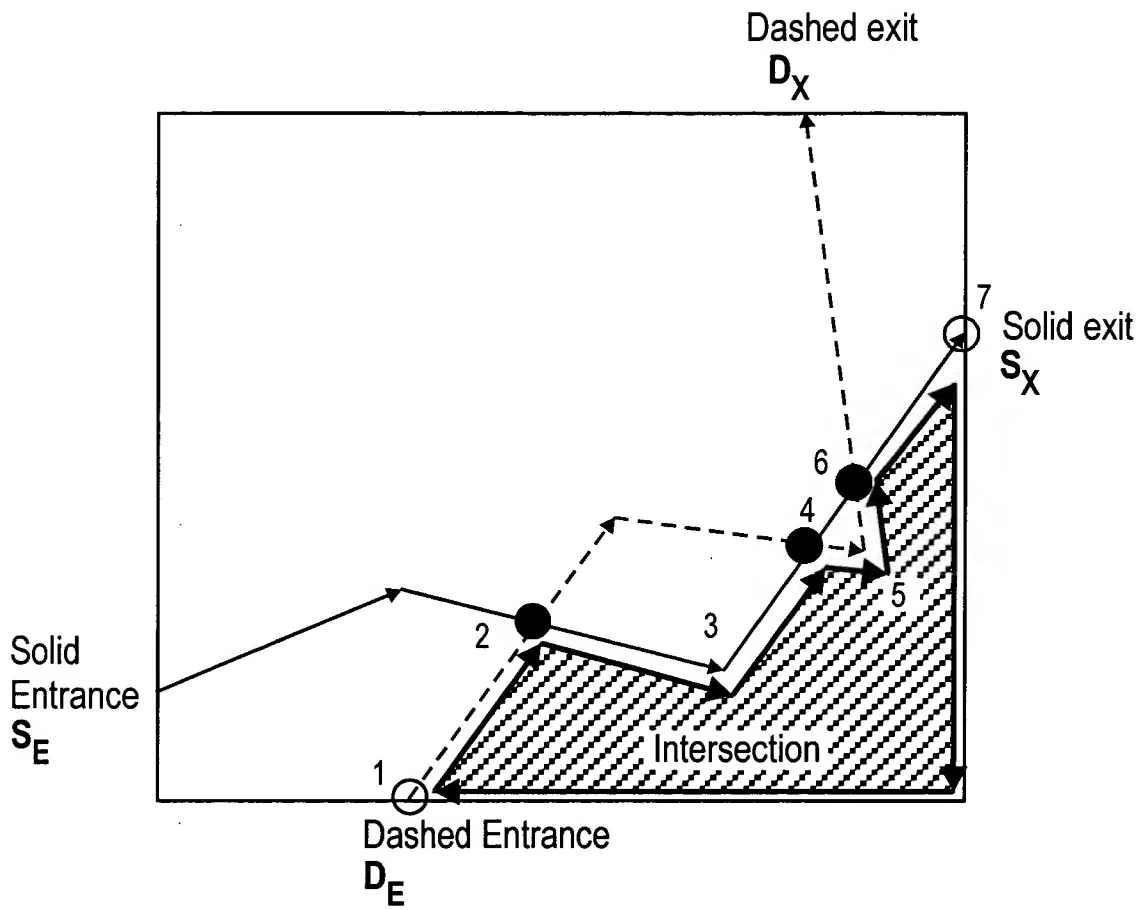

Dashed exit
D_X
7
Solid exit
S_X
6
4
5
3
2
Solid
Entrance
S_E
Intersection
1
Dashed Entrance
D_E

FIG. 17

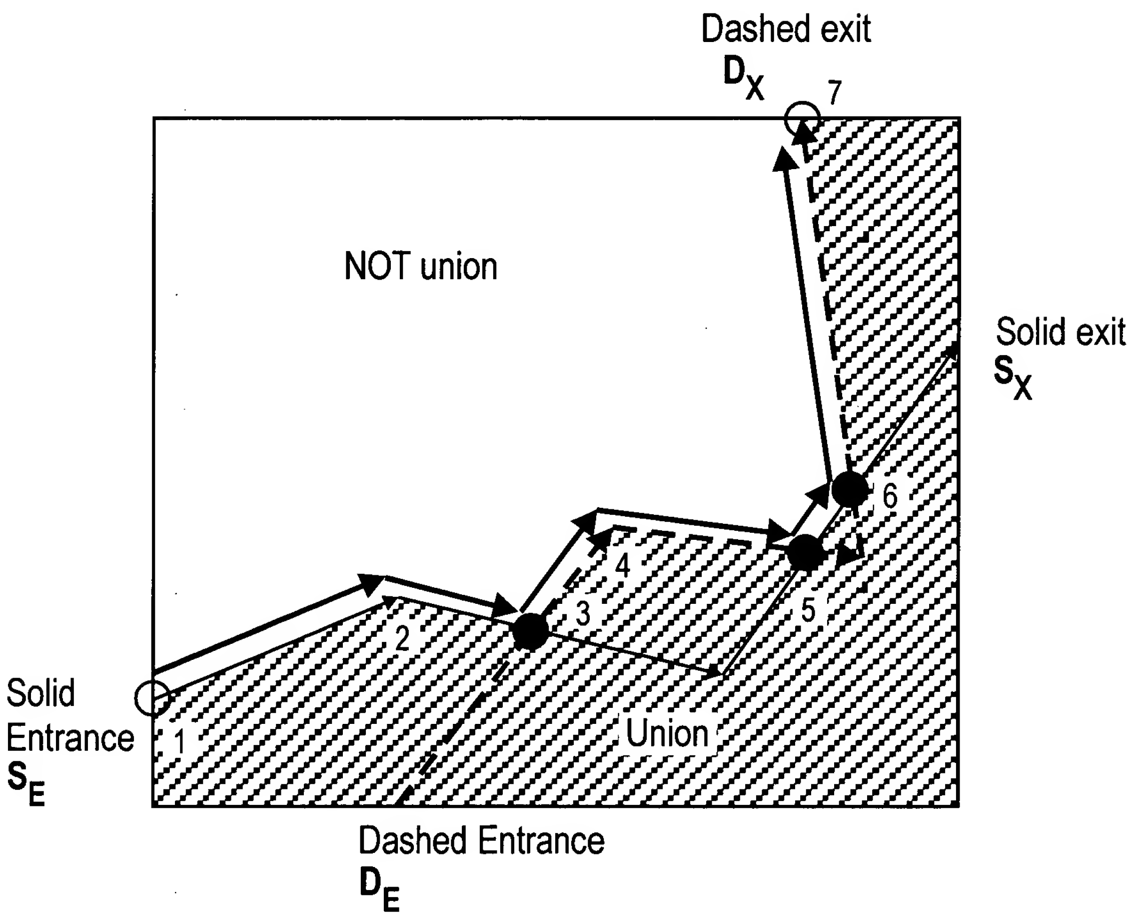

Dashed exit
D_X
7
NOT union
Solid exit
S_X
6
4
5
3
2
Solid
Entrance
S_E
1
Union
Dashed Entrance
D_E

FIG. 18

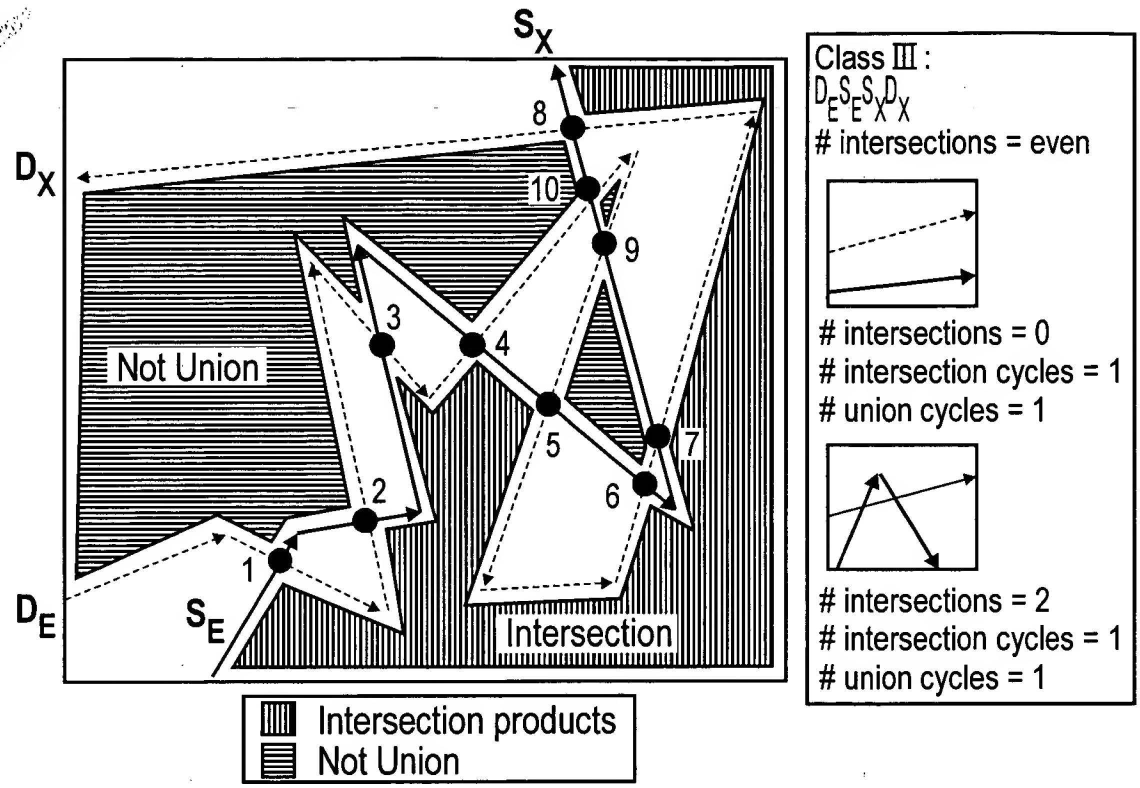

S_X
D_X
D_E
S_E
Not Union
Intersection
1
2
3
4
5
6
7
8
9
10
Class III :
$D_E S_E S_X D_X$
intersections = even
intersections = 0
intersection cycles = 1
union cycles = 1
intersections = 2
intersection cycles = 1
union cycles = 1
Intersection products
Not Union

FIG.1 9

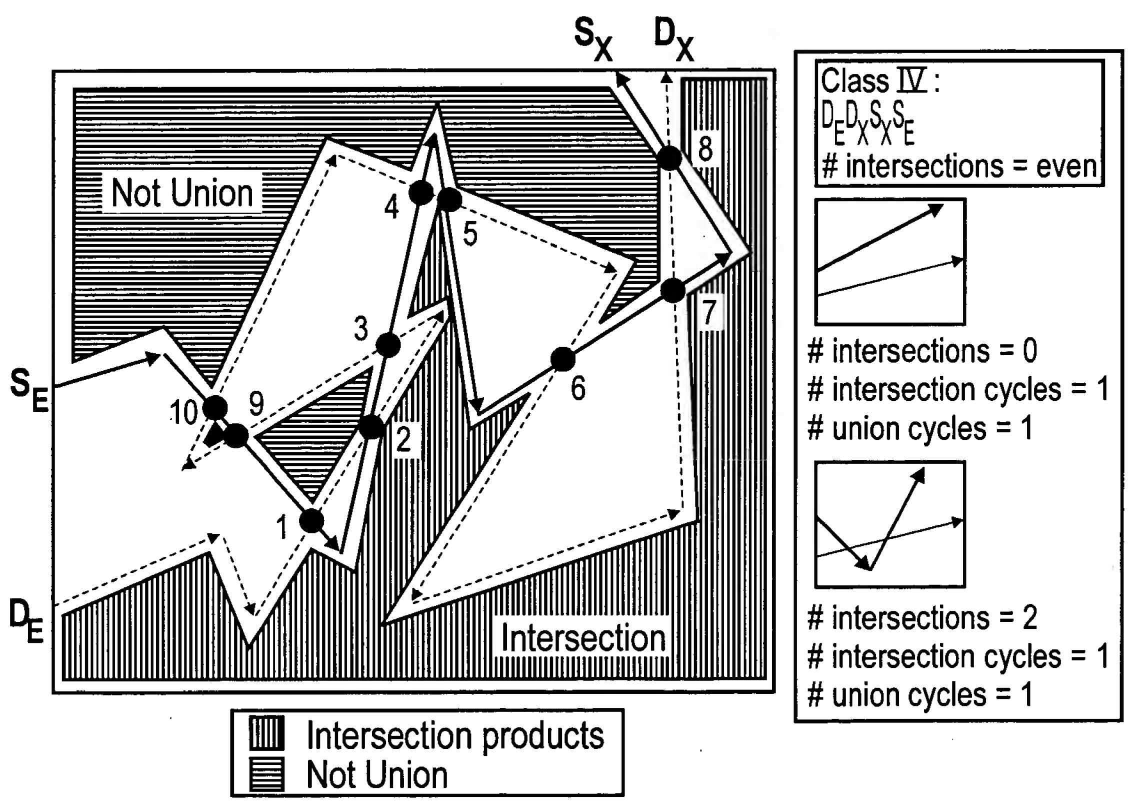

S_X
D_X
S_E
D_E
Not Union
Intersection
1
2
3
4
5
6
7
8
9
10
Class IV :
$D_E D_X S_X S_E$
intersections = even
intersections = 0
intersection cycles = 1
union cycles = 1
intersections = 2
intersection cycles = 1
union cycles = 1
Intersection products
Not Union

FIG. 20

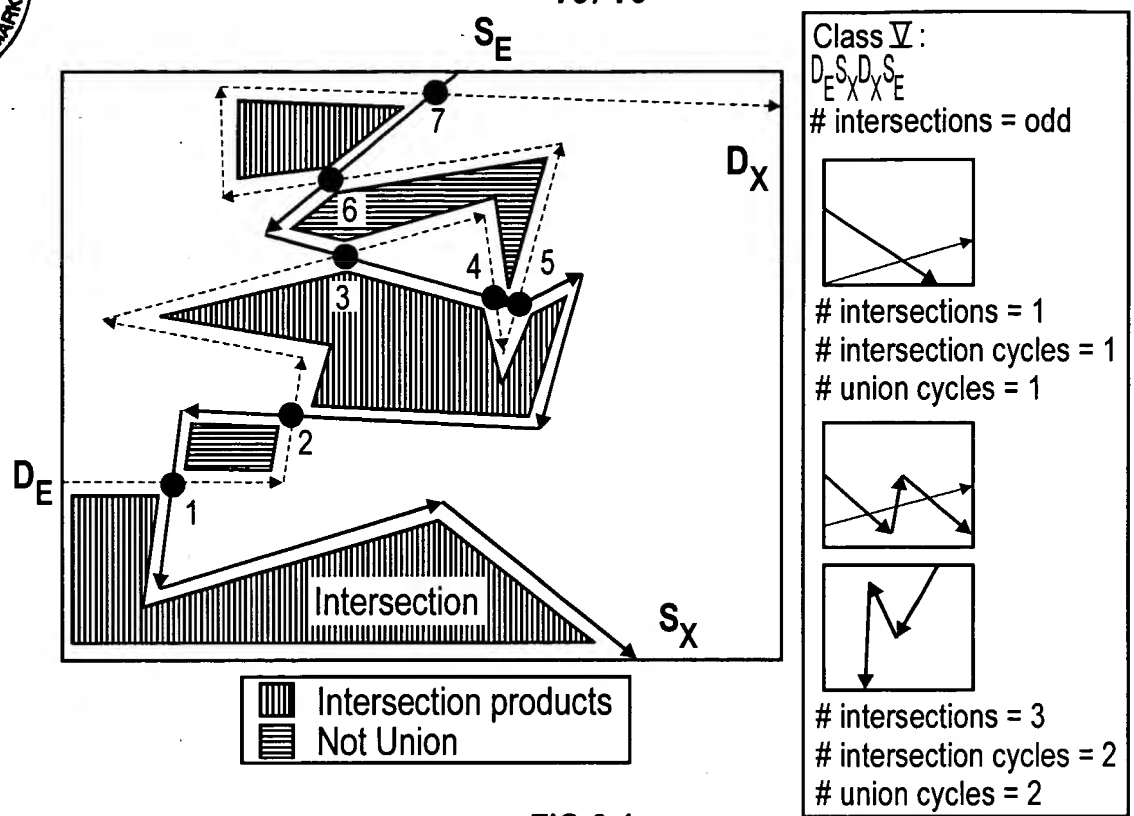

SE
DX
DE
SX
1
2
3
4
5
6
7
Intersection
Intersection products
Not Union
Class V :
DESXDXSE
intersections = odd
intersections = 1
intersection cycles = 1
union cycles = 1
intersections = 3
intersection cycles = 2
union cycles = 2

FIG.21

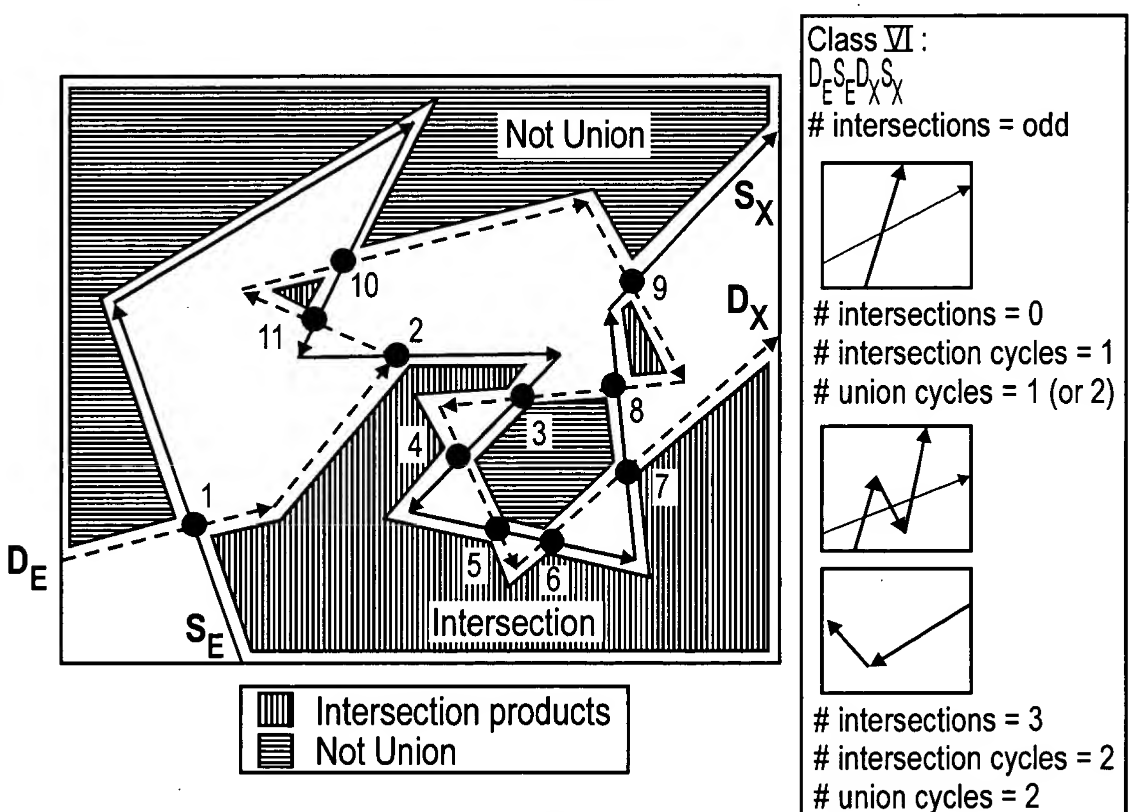

Not Union
SX
DX
DE
SE
1
2
3
4
5
6
7
8
9
10
11
Intersection
Intersection products
Not Union
Class VI :
DESEDXSX
intersections = odd
intersections = 0
intersection cycles = 1
union cycles = 1 (or 2)
intersections = 3
intersection cycles = 2
union cycles = 2

FIG.22

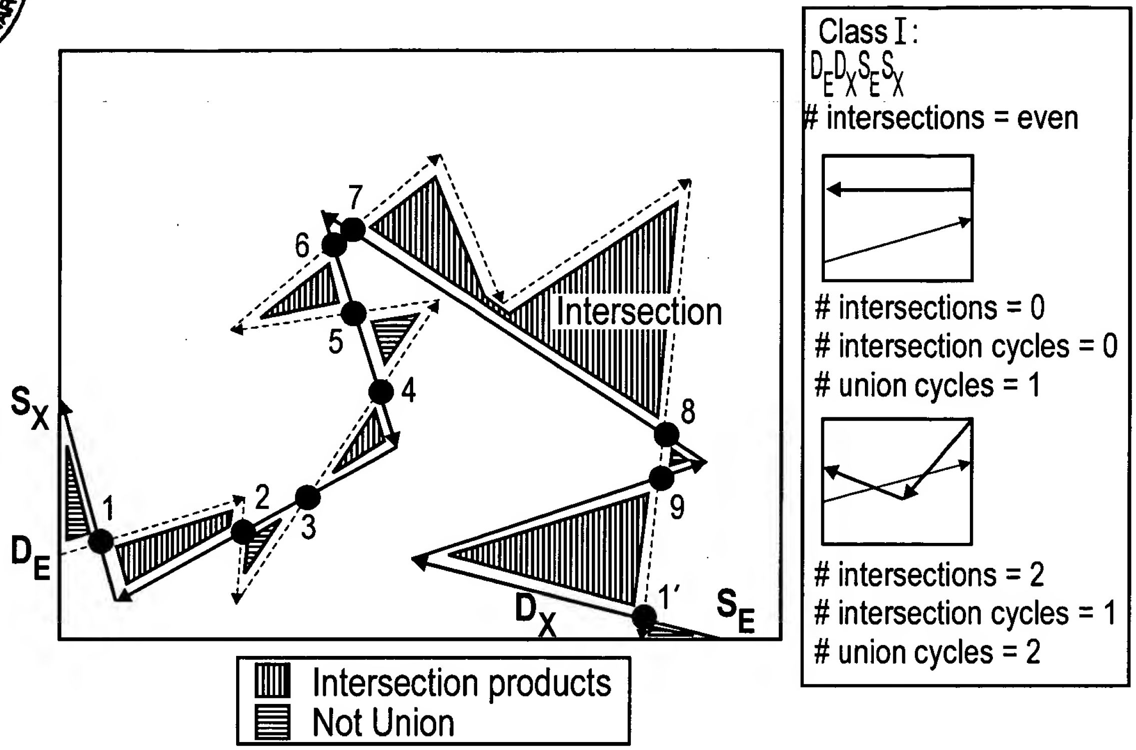

Class I:
$D_E D_X S_E S_X$
intersections = even
intersections = 0
intersection cycles = 0
union cycles = 1
intersections = 2
intersection cycles = 1
union cycles = 2
S_X
D_E
D_X
S_E
Intersection
1
2
3
4
5
6
7
8
9
1′
Intersection products
Not Union

FIG.23

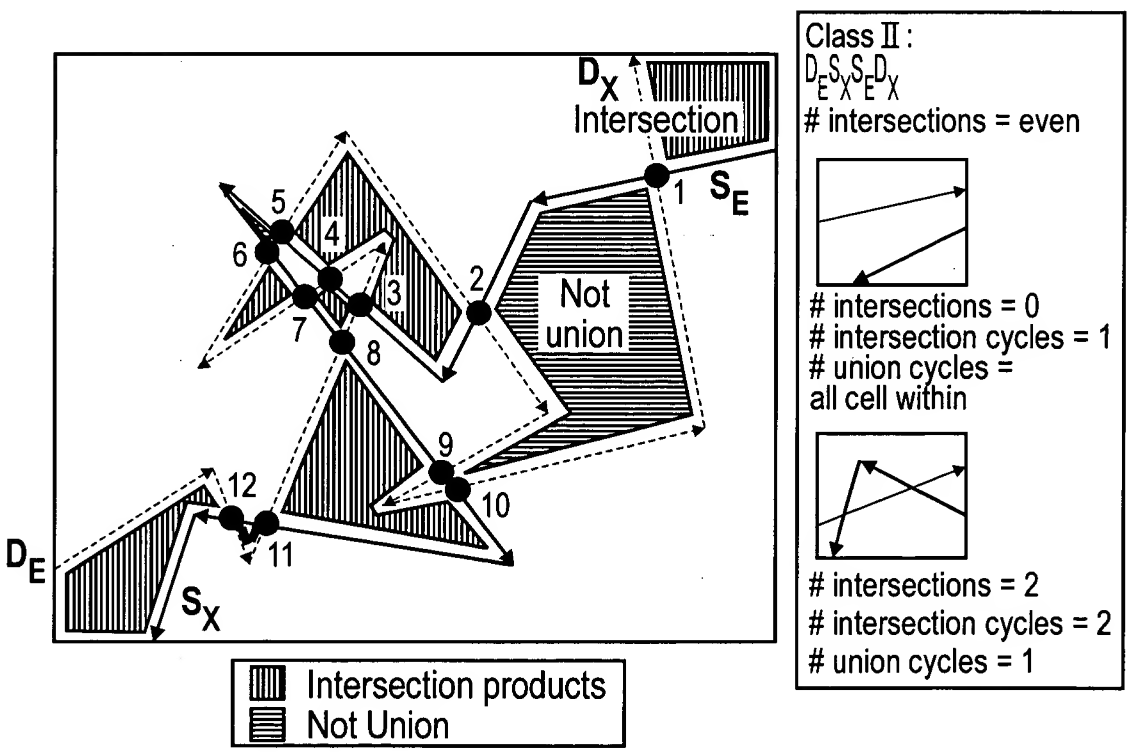

Class II:
$D_E S_X S_E D_X$
intersections = even
intersections = 0
intersection cycles = 1
union cycles =
all cell within
intersections = 2
intersection cycles = 2
union cycles = 1
D_X
Intersection
S_E
Not
union
D_E
S_X
1
2
3
4
5
6
7
8
9
10
11
12
Intersection products
Not Union

FIG.24

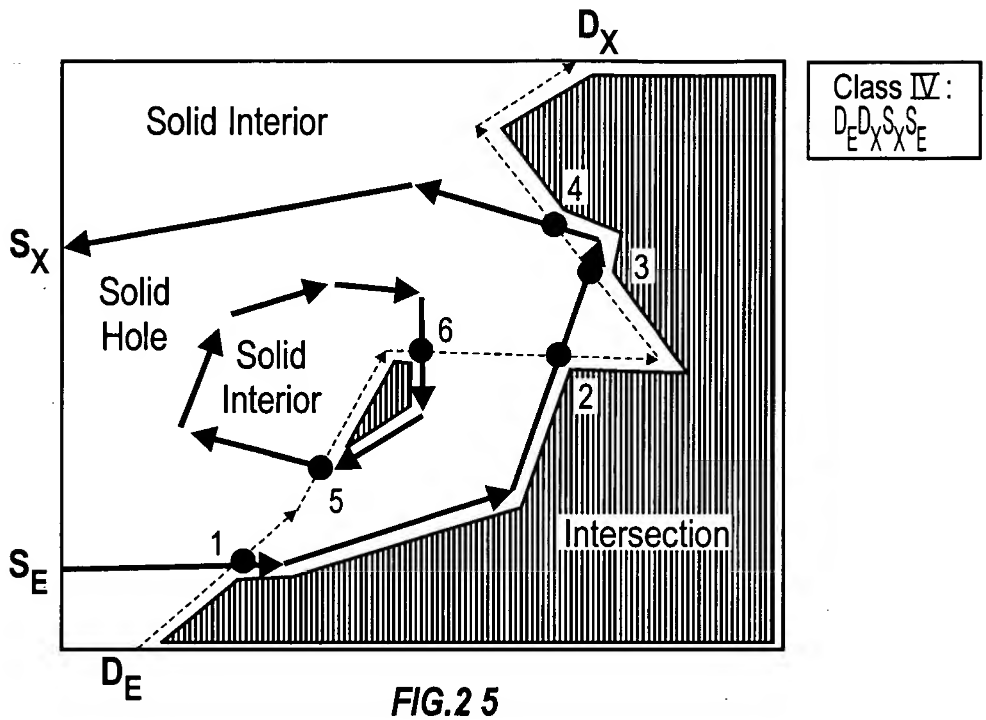

D_X
Class IV: $D_E D_X S_X S_E$
Solid Interior
4
S_X
3
Solid
Hole
Solid
Interior
6
2
5
1
Intersection
S_E
D_E

FIG.2 5

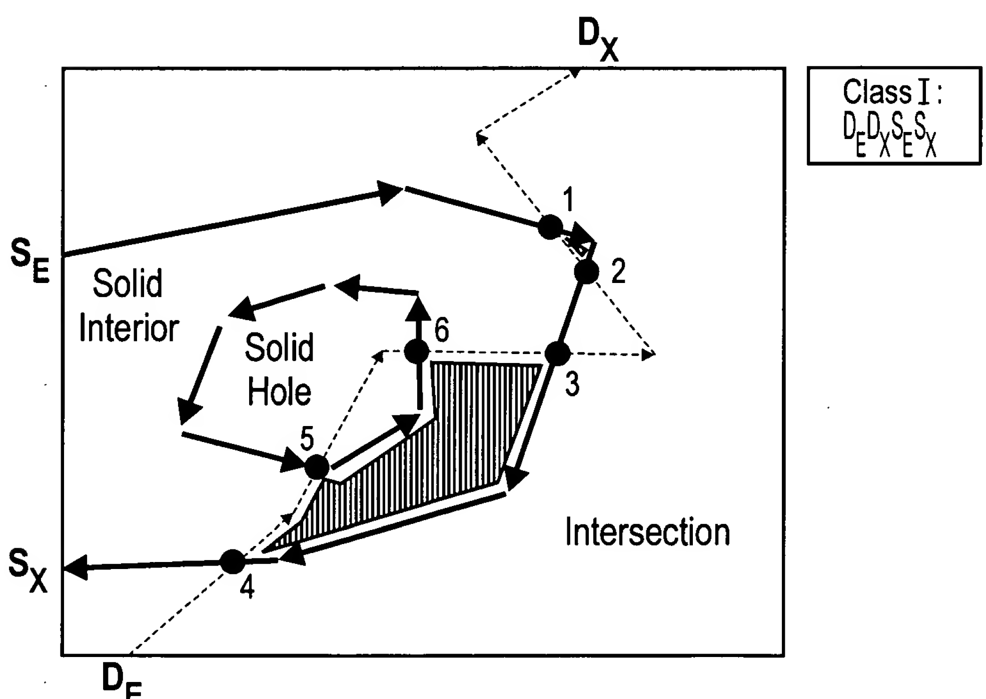

D_X
Class I: $D_E D_X S_E S_X$
1
S_E
2
Solid
Interior
6
Solid
Hole
3
5
Intersection
S_X
4
D_E

FIG.2 6

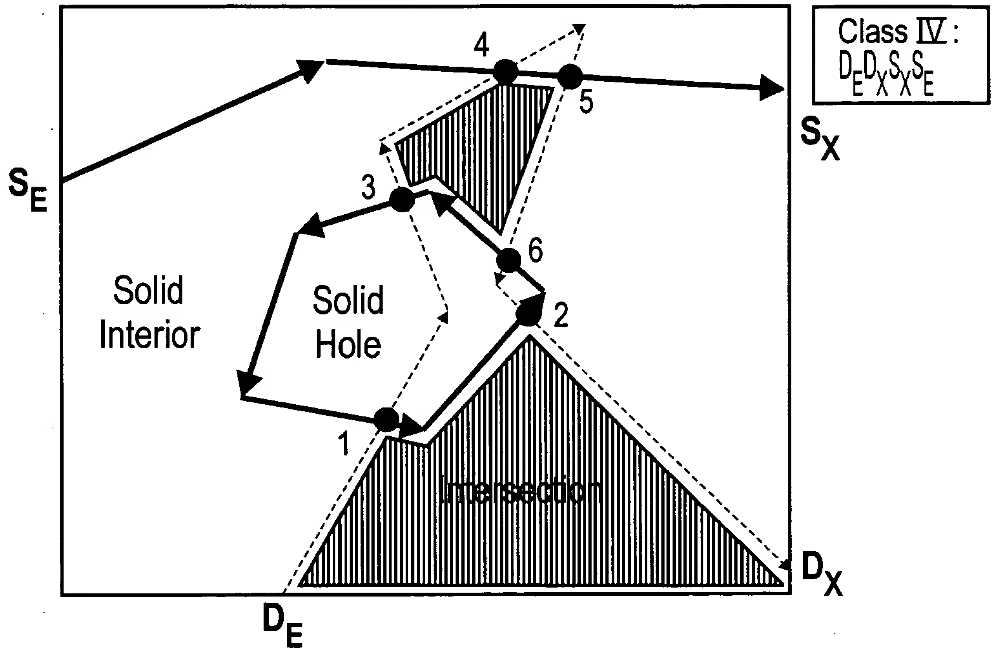

4
5
S_X
S_E
3
6
Solid Interior
Solid Hole
2
1
Intersection
D_X
D_E
Class IV: $D_E D_X S_X S_E$

FIG.27

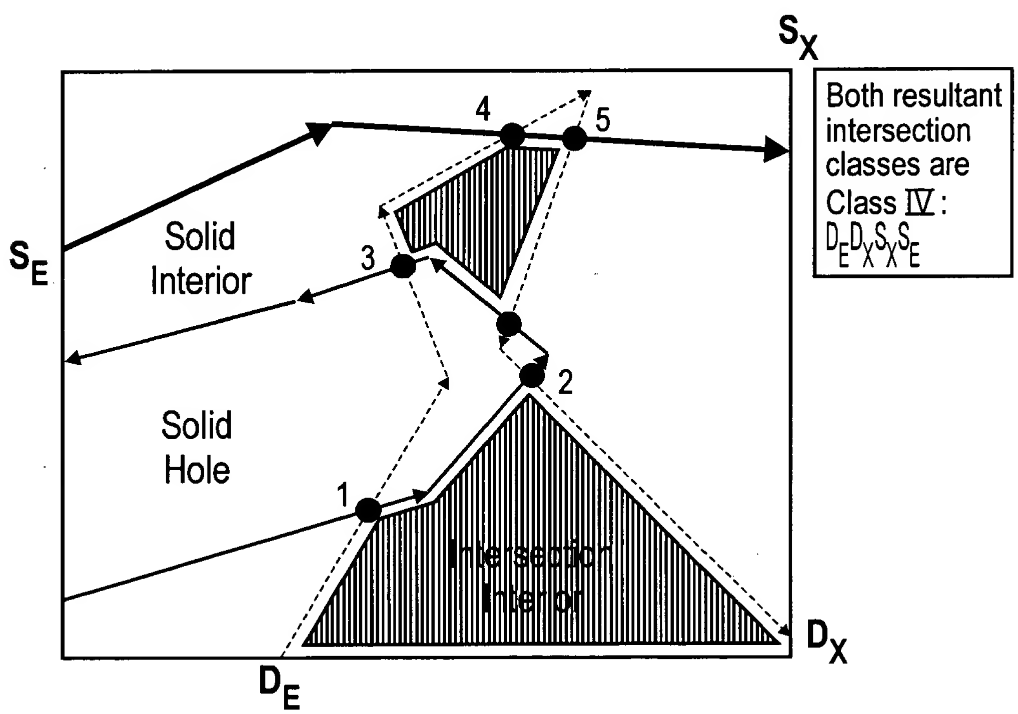
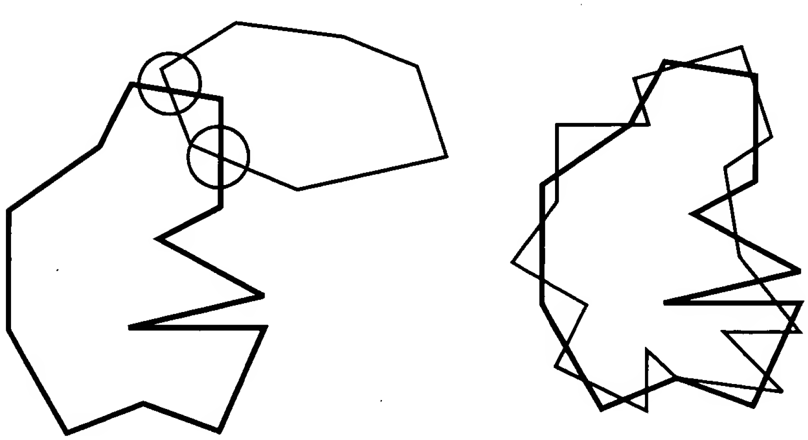

S_X
4
5
S_E
Solid Interior
3
2
Solid Hole
1
Intersection Interior
D_X
D_E
Both resultant intersection classes are Class IV: $D_E D_X S_X S_E$

FIG.28

Entry/Exit Relationship	Class	Total # of Intersection tuples within cells	Entry/exit relationship adjacent/ alternating	Special cases # Intersect points	Total Intersect Cycles (to the right)	Total # of NOT union cycles (to the right)	Total Intersect Cycles (to the left)	Total # of NOT union cycles (to the left)
$D_E D_X S_E S_X$	I	even	Adjacent	0 2	0 1	2 2	1 1	Full cell 2
$D_E S_X S_E D_X$	II	even	Adjacent	0 2	1 2	Full cell 1	0 2	2 1
$D_E S_E S_X D_X$	III	even	Adjacent	0 2	1 1	1 1	1 1	1 1
$D_E S_E D_X S_X$	VI	odd	Alternating	1	1	1	1	1
$D_E D_X S_X S_E$	IV	even	Adjacent	0 2	1 1	1 1	1 1	1 1
$D_E S_X D_X S_E$	V	odd	Alternating	1	1	1	1	1

FIG.2 9



(a) (b)

FIG.3 0